CHAPTER 6: WATER SERVICES ASSESSMENT

Introduction

The need for water protection in North Carolina is vital to the future health, well-being and economy of its citizens. Given the importance of this valuable resource, a separate Water Services Assessment was needed as part of the overall Conservation Planning Tool. This assessment has been divided into two separate sections. This report covers the preservation concerns for North Carolina waters. The restoration concerns and available data will be studied and compiled, ready for use in the winter of 2009.
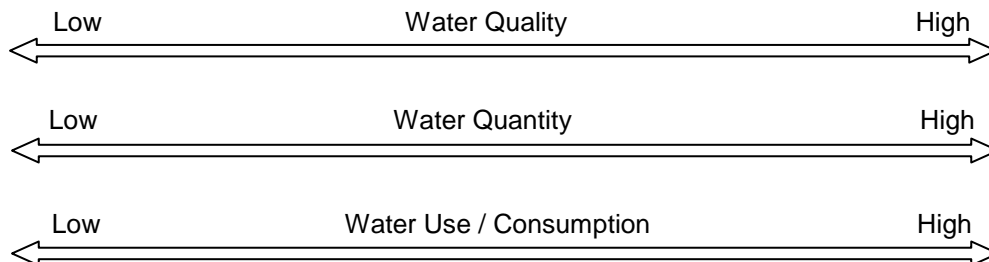
Upon completion of the Biodiversity and Wildlife Habitat Assessment in June 2007, a group of water resource professionals was assembled to develop a Water Services Assessment. The purpose of this assessment is to identify which lands are most critical to conserve in order to protect the water resources that serve the needs of North Carolina's residents.

The Water Assessment Team consisted of representatives of the Division of Water Quality, the Division of Water Resources, the Division of Environmental Health, the Ecosystem Enhancement Program and the Clean Water Management Trust Fund. This initial group of professionals was tasked with developing an approach, methodology and a draft of data sets and rankings for the Water Services Assessment. This process was then reviewed and validated by a wide variety of professionals within state, federal and local governments, along with environmental nonprofits and special watershed interest groups.

Methodology

The Water Assessment Team chose to follow a relative ranking approach similar to that used in the Biodiversity and Wildlife Habitat Assessment. Selection of a raster-based GIS (30 meter) analysis assured compatibility with the previous assessments. A set of "guiding principles" define the scope, or conservation goals, of this assessment.

Guiding Principles for Water Services Preservation Assessment

Low	Water Quality	High

Low	Water Quantity	High

Low	Water Use / Consumption	High

These principles were used to guide the selection of the resource data sets for analysis and their subsequent relative ranking. Based on these principles, 42 different data sets were selected to represent the resources in the landscape that most directly influence water services.

Data spatial precision, accuracy and completeness were specifically included as a guiding principle for relative ranking in the Biodiversity and Wildlife Habitat Assessment. For the Water Services Assessment, these factors were not guiding principles, but were used only as a guide in selecting the data sets themselves. Those data sets that were determined not to be spatially precise, accurate or complete were not selected.

For the purposes of this assessment, the Water Services Assessment Team has identified the Riparian Zone of Interest as having a width of 300 feet or 100 percent of the 100-year floodplain, whichever is wider, in the Water Services Assessment Map. This represents an area of value for a wide range of frequently occurring considerations for water resource conservation across North Carolina, and is the zone to which prioritization points will be applied. These considerations may include drinking water quality and supply, public health and recreation, aquatic and terrestrial ecosystem health, control of non-point source contamination, the variety and status of important wildlife habitats, and flood control.

Review of research, other literature reviews and recommendations by various organizations supports the team consensus for a statewide riparian zone, the area of importance to the typical range of water-oriented resource types, of 300 feet. It is clear from the literature and discussion that riparian zone width effectiveness varies a great deal depending on the contaminant(s) of concern, the ecosystem to be protected or restored, the desired use of the waters, the adjacent land use, soil type and vegetative cover, topography and geology. Literature recommendations include width ranges of from 25 to 1,000 feet, depending upon the above variables.

The Riparian Zone of Interest delineation:
- Is not a recommendation for a requirement of conservation planning, activities or regulation
- Is an attempt to depict a statewide, non-site-specific riparian area of importance to be considered in water resource conservation planning and implementation

Site-specific conditions and objectives will determine alternate widths for effective conservation. The most common considerations include sediment, nutrients (nitrogen and phosphorus) and the health and status of aquatic and terrestrial habitat. Riparian zones of at least 300 feet are needed for terrestrial and semi-

aquatic wildlife species. Other considerations may include metals, pathogens, pharmaceuticals and commercial or industrial run-off.

See "Appendix G: References" for literature sources reviewed for the Water Services Assessment.

Basis for Ranking

The Water Services Assessment uses an additive approach; the initial relative ranking score is combined with possible bonus points, if multiple resources occur in the specified area. The final scores for each 30 x 30 meter grid cell range from two (2) to seventeen (17).

Initial relative ranking / maximum score: The initial relative ranking score yields a maximum score of one (1) through ten (10), based strictly on the highest scoring data set that occurred in a given grid cell (see Appendix D for Relative Criteria Ranking).

A cell may receive a value for multiple data factors found to exist in that location, but only the highest (maximum) score and corresponding color appears on the map. This allows the user to quickly assess the relative value of an area of interest.

Bonus points on a weighted scale: A simple three-tiered weighting system of "bonus points" was used for cells that receive multiple scores, in order to account for each additional conservation value in that area of the landscape.

Those data sets that were identified as an already integrated or combined set of data were not given additional "bonus points." For example, the data sets ORW and HQW could not be added together, since much of the same information goes into building both data sets. Avoiding overlap in this way reduces double counting of data sets.
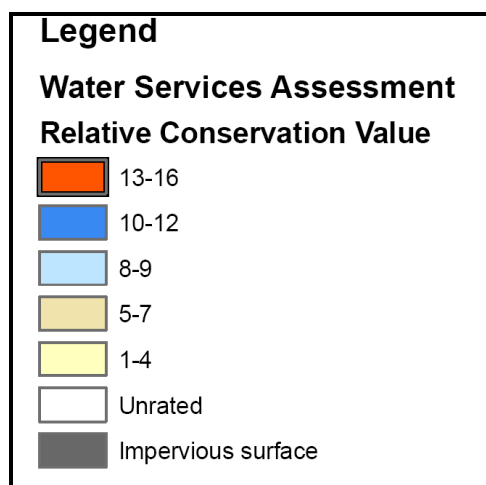
Weighted Scale for Ranking Water Services		
Conservation Value	Ranking Range	Possible Bonus Points (if multiple values are identified)
moderate	1 - 4	.5
medium	5 - 7	1
highest	8 -10	1.5

Additive Approach: If a cell contains multiple occurrences of resources, then points can be added to the maximum score, reflecting the additional conservation value.

Example of Additive Approach				
Identified Resources in the Selected Cell	Initial Relative Ranking (based on Conservation Value)	Highest Value = Maximum Score for Selected Cell	Bonus Points for Additional Resource Occurrence	Final Score
ORW	10 (highest)	10		
GW natural cover	6 (medium)		1	
Class_B Waters	7 (medium)		1	
TOTAL		**10 +**	**2 =**	**12**

All of the scores can be viewed through the use of a value attribute table (VAT) that identifies all data associated with that cell. This data provides additional information that may point to collaboration opportunities and potential funding sources that focus on particular types of resources.

In addition to these scored data sets, placeholders for two future data sets are included in the relative rankings: Future Water Supplies and Head Waters. While these data sets have not been developed yet, they are considered vital to a more complete understanding of the value of resources related to water services. The assessment team strongly recommends the development of these data sets in the near future.

Legend

Water Services Assessment

Relative Conservation Value

- 13-16
- 10-12
- 8-9
- 5-7
- 1-4
- Unrated
- Impervious surface

Data Sources

Data for this assessment was gathered from the most up-to-date sources available. The Water Assessment Team either had thorough knowledge of the data or met with the source creators to understand the content, context and best uses of the data. Data was gathered from DENR divisions and other partner agencies. The majority of data was provided by DENR, whose multiple agencies worked together to reach consensus on prioritization.

This section is divided up into three categories:
- o **Water Quality**
- o **Water Quantity**
- o **Use / Consumption**

There are data sets that represent or measure more than one category; however, the detailed explanation of the data set will be in the primary focus area of this section.

Water Quality	Water Quantity	Water Use/ Consumption
All streams	All streams	
Floodplains	Floodplains	
Headwaters	Headwaters	
Groundwater (Land Cover)	Groundwater (Land Cover)	
Future Water Supply	Future Water Supply	
Class - SC, SB, C, B		Class - SC, SB, C, B
Water Supply WS - I to V		Water Supply WS - I to V
Outstanding Resource Waters		Outstanding Resource Waters
High Quality Waters		High Quality Waters
SWAP Susceptibility Rate Data		SWAP Susceptibility Rate Data
Shellfish Waters data		Shellfish Waters data
Recreational Waters		Recreational Waters
Designated Rivers		Designated Rivers
Native Trout Waters		Native Trout Waters
CREWS data		
Unique Wetlands		
National Wetland Inventory		
Fish Community Data		
Benthos data		
Riparian Zones & 100 yr. Flood Plains		

Water Quality Category

All surface waters in North Carolina are assigned a primary classification by the NC Division of Water Quality. Numeric and narrative standards apply to each classification to protect the use of the water body.
 (Please refer to DWQ's Web site for a full list of primary and supplemental classifications, their definitions and locations.)

- All waters must at least meet the in-stream water quality standards for Class C (fishable / swimmable) waters.
- The other primary classifications provide additional levels of protection for:
  - Primary water contact recreation (Class B) and
  - Drinking water (Water Supply Classes I through V)

The following are the primary classifications used for the purpose of the Conservation Planning Tool. All of these data were selected as measures of water quality and use/consumption for this relative ranking.

Primary Classifications

Water Supply (W-S) Waters Classifications		
Classification	**Ranking for Water Services Assessment**	**Numeric and Narrative Standards**
Water Supply I (WS-I)	10	Water Supply I are waters protected for all Class C uses plus waters used as sources of water supply for drinking, culinary or food processing purposes for those users desiring maximum protection for their water supplies. WS-I waters are those within natural and undeveloped watersheds in public ownership. All WS-I waters are HQW by supplemental classification.
Water Supply II (WS-II)	9	Water Supply II are waters used as sources of water supply for drinking, culinary or food processing purposes where a WS-I classification is not feasible. These waters are also protected for Class C uses. WS-II waters are generally in predominantly undeveloped watersheds. All WS-II waters are HQW by supplemental classification.
Water Supply III (WS-III)	7	Water Supply III are waters used as sources of water supply for drinking, culinary or food processing purposes where a more protective WS-I or II classification is not feasible. These waters are also protected for Class C uses. WS-III waters are generally in low to moderately developed watersheds.
Water Supply IV (WS-IV)	5	Water Supply IV are used as sources of water supply for drinking, culinary or food processing purposes where a WS-I, II or III classification is not feasible. These waters are also protected for Class C uses. WS-IV waters are generally in moderately to highly developed watersheds or protected areas.

Water Supply V (WS-V)	4	Water Supply V are waters protected as water supplies that are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses.
Class Waters Classifications		
Classification	**Ranking for Water Services Assessment**	**Numeric and narrative standards**
Class _SC (General Purpose saltwater)	4	Class SC waters are all tidal salt waters protected for secondary recreation such as fishing, boating and other activities involving minimal skin contact; fish and noncommercial shellfish consumption; aquatic life propagation and survival; and wildlife.
Class SB (Recreation Saltwater)	7	Class SB waters are tidal salt waters protected for all SC uses in addition to primary recreation. Primary recreational activities include swimming, skin diving, water-skiing and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis.
Class _C (General Purpose freshwater)	4	Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating and other uses involving human body contact with water where such activities take place in an infrequent, unorganized or incidental manner.
Class _B (Primary Recreation freshwater)	7	Class B waters are protected for all Class C uses in addition to primary recreation. Primary recreational activities include swimming, skin diving, water-skiing and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis.

Supplemental Classifications

The following are the supplemental classifications used for the purpose of the DENR Conservation Planning Tool. These are sometimes added through rulemaking by DWQ to the primary classifications to recognize and provide additional protection to waters with special uses or values. Numeric and narrative standards apply to each classification to protect the use of the water body.

Supplemental Classifications		
Classification	**Ranking for Water Services Assessment**	**Numeric and Narrative Standards**
Future Water Supply	6	Future Water Supplies are a supplemental classification for waters intended as a future source of drinking,

(FWS)		culinary or food processing purposes. FWS would be applied to one of the primary water supply classifications (WS-I, WS-II, WS-III, or WS-IV). Currently no water bodies in the state carry this designation.
High Quality Waters (HQW)	9	High Quality Waters are a supplemental classification intended to protect and recognize waters that are rated excellent based on biological and physical/chemical characteristics through DWQ monitoring or special studies, primary nursery areas designated by the Marine Fisheries Commission, and other functional nursery areas designated by the Marine Fisheries Commission. This category includes the subset class of SA- Waters.
Outstanding Resource Waters (ORW)	10	All outstanding resource waters are a subset of High Quality Waters. This supplemental classification is intended to protect and recognize unique and special waters having excellent water quality and being of exceptional state or national ecological or recreational significance. To qualify, waters must be rated Excellent by DWQ and have one of the following outstanding resource values: - Outstanding fish habitat and fisheries, - Unusually high level of water-based recreation or potential for such kind of recreation, - Some special designation such as North Carolina Natural and Scenic River or National Wildlife Refuge, - Important component of state or national park or forest, or - Special ecological or scientific significance (rare or endangered species habitat, research or educational areas).
Unique Wetland (UWL)	9	Unique wetlands are a supplemental classification for wetlands of exceptional state or national ecological significance. These wetlands may include wetlands that have been documented to the satisfaction of the Environmental Management Commission as habitat essential for the conservation of state or federally listed threatened or endangered species.
Benthos Database, Good	5	Benthos Data provide locality and collection information with latitude and longitude for benthic macro invertebrates (aquatic bugs). Level of identification depends upon the taxonomic group.
Benthos Database, Excellent	9	Qualitative data ranked as Abundant, Common or Rare. Data covers the period from early to mid-1980s to present and consists of approximately 10,000 samples. Data helps indicate relative health of a water body.
Fish Community Database, Good	5	Fish Community data provide complete stream locality and collection information with latitude and longitude, fish species level identifications for all species, number of fish of each species collected following a standard sampling reach of 600 feet. Raw data is converted into North Carolina Index of Biotic Integrity scores and biological ratings (Excellent to Poor) for each sample. Data covers the period from about 1990 to present and consists of approximately 1,300 samples. Data helps indicate the relative health of a water body.
Fish Community Database, Excellent	9	

ORW NOTE: It has recently come to our attention that in the event that an ORW temporarily deteriorates, it can be simultaneously listed on the 303D list. This "temporary" action does not take the water body off of the ORW list. Therefore, you should cross reference these two data sets with DWQ during your evaluation process. We will address this issue in the next iteration of the CPT.

Wetlands

Wetlands provide multiple ecosystem services; however, they are explained in this section because of their water quality benefits. Wetlands play particularly important roles in hydrologic cycling, water quality and nutrient cycling, as well as serving as important kinds of habitat and distinctive sites for many other ecosystem functions. Wetlands are areas of land where hydric conditions are a dominant environmental factor. The standard definition of wetlands that fall under federal jurisdiction as waters of the United States requires that:
- Soils be saturated with water for at least two weeks during the growing season,
- Soils show characteristics created by saturation, and
- Vegetation be composed predominantly of hydrophytes (plants adapted to growing in water or on a substrate that is deficient in oxygen due to excessive water content) (USACE 1987).

As a general class individual wetlands are not highly unique however they are all valuable resources. Rare types and particularly high quality occurrences are covered by Significant Natural Heritage Areas (SNHAs) and community Element Occurrences (EOs) in the Biodiversity and Wildlife Habitat Assessment, so this data layer represents the remaining wetlands.

Wetland Classifications		
Classification	**Ranking for Water Services Assessment**	**Numeric and Narrative Standards**
CREWS, Exceptional	9	N. C. Coastal Region Evaluation of Wetland Systems (NCCREWS): In the North Carolina outer Coastal Plain, wetlands maps were refined by the NC Division of Coastal Management, and were rated for function by a multi-factor rating model called the Coastal Region Evaluation of Wetland Systems. Ratings were exceptional, substantial and beneficial function (NCCREWS, 2003). NC CREWS data represents a higher level of accuracy, and has an internal rating that allows differentiation among different levels of condition or function. The most functional wetlands with the highest level of accuracy are therefore ranked higher, and the least functional and least accurate are ranked lower.
CREWS, Substantial	6	
CREWS, Beneficial	2	
National Wetland Inventory (NWI)	5	National Wetland Inventory (NWI): Wetlands across North Carolina were mapped by the National Wetland Inventory (NWI, 1983) of US Fish and Wildlife Service,

		In the parts of the state where wetlands are represented by NWI (in the Piedmont and Mountains), wetlands are rare and very important. NWI mapping represents only a moderate level of accuracy, and does not have a scale to determine condition or integrity. These areas are therefore given a fairly low ranking but not the lowest, and are not used in areas where CREWS data is available.

Other Data Sets

Three additional data sets are included as measures of water quality and quantity:

<table>
<tr><th colspan="3">Classification of Other Data Sets</th></tr>
<tr><th>Classification</th><th>Ranking for Water Services Assessment</th><th>Justification</th></tr>
<tr><td>Head Waters</td><td>8</td><td>Head waters represent both water quality and quantity issues; however, they are explained in this section due to their importance related to water quality.

Although not available for North Carolina, this data set would be very valuable in assessing important water resources across the state.</td></tr>
<tr><td>Native Trout Waters</td><td>9</td><td>Although Native Trout Waters represent both a measure of water quality and use, they are explained here due to their water quality measures.</td></tr>
<tr><td>Riparian Zones and 100 Year Flood Plains</td><td>2</td><td>Riparian zones and flood plains provide many ecosystem services. The two that are focused on here are water quality, as they act as filters, and water quantity, as they slow flood waters.</td></tr>
</table>

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Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, impairment of headwater streams can (and does) impact the larger stream or river.

Headwater areas are found from the mountains to the coast along all river systems and drain all of the land in a river basin. Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use

management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

For a more detailed description of watershed hydrology, please refer to EPA's Watershed Academy Web site:
http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

Native Trout Waters: Although Native Trout Waters represent both a measure of water quality and use, they are explained here due to their water quality measures.

These are waters that contain the naturally occurring and reproducing strains of Northern and Southern Appalachian Brook Trout. The stream reach where the native trout are known to occur, along with its 100-foot land buffer, is included in the model. Mapping and management of data related to Brook Trout Waters is conducted by the Wildlife Resources Commission.

The Southern Appalachian Brook Trout is the only native trout species in North Carolina, and they serve as indicators of the health of the watersheds they inhabit. Robust wild brook trout populations demonstrate that a stream or river ecosystem is healthy and that water quality is excellent. They indicate good examples of a particular kind of aquatic community.

These waters represent a portion of the most significant aquatic communities in the state. They are based on well-studied sample points that represent a high level of site-specific knowledge of community condition, and therefore receive a (9) ranking.

Riparian Zones of Interest and 100-Year Flood Plains: Riparian zones and flood plains provide many ecosystem services. The two that are focused on here are water quality, as they act as filters, and water quantity, as they slow flood waters.

- Riparian Zones: A riparian zone is land adjacent to ephemeral, intermittent and perennial streams, rivers and other bodies of water that serves as a transition zone between aquatic and terrestrial environments and directly affects or is affected by that body of water. Riparian ecosystems perform many functions that are essential to maintaining water quality, aquatic species survival and biological productivity. Riparian buffer conservation represent the most effective and efficient way we can address water quality and habitat through spatial planning, and should be part of a larger holistic strategy for the conservation of aquatic ecosystems. The overall implementation strategy should take into account increased impervious surface and stormwater impacts, and human

practices that can bypass or circumvent intact riparian buffers. In this assessment, a 300-foot riparian zone or the 100-year flood plain, whichever is greater, has been identified as a priority for conservation on the associated map.

Riparian zone width effectiveness in nutrient delivery reductions may decline over time. For example, some studies suggest effective widths for phosphorus to be at least 280 feet for long-term maintenance of an 80 percent reduction in delivery to surface waters. For aquatic, semi-aquatic and terrestrial wildlife species the literature is in great agreement that riparian zones of at least 300-foot wide are essential; sometimes more for particularly sensitive species.

- Flood Zones: Selected Flood Zone polygons were extracted from the N.C. Floodplain Mapping Program's Digital Flood Insurance Rate Map (DFIRM) GIS database and were aggregated into a single presence/absence "100 year floodplain" raster dataset. Ninety-seven out of 100 N.C. counties had either preliminary or effective DFIRMs at the time of compilation for this dataset. Missing counties are expected to be delivered from contractors in summer 2008 and will be included in the next iteration of the water services assessment.

Selected Flood Zone Designations	
A	1-percent annual chance by approximate methods of analysis
AE	1-percent annual chance by detailed hydraulic analysis
AH	1-percent annual chance shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet.
AO	1-percent shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet.
V & VE (if coincide with land areas)	1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. In some areas, these coastal velocity zones partially occupy areas of the sounds and intracoastal waterways. Only land areas were included in this assessment.

Riparian Zones of Interest combined with100-year Floodplains: In this assessment, a 300-foot riparian zone or the 100-year flood plain (whichever is greater) has been identified as a priority for conservation on the associated map. The 300-foot riparian zones of interest were combined with the 100 year floodplains into a single dataset.

WEIGHTED SCALE FOR RANKING Riparian Zones combined with 100-year Floodplains	
Conservation Value	Possible Bonus Points if multiple values were identified
Standard composite dataset	2 points
Additional similarly ranked dataset	Add 0.5 point.
Additional higher ranked dataset	Use the higher ranking, plus bonus points for multiple occurrences.

Water Quantity Category

Protection of groundwater quality and quantity is fundamental to protecting both surface waters and groundwater; however, it is explained here because of its measure of water quantity. Roughly 50 percent of North Carolinians rely on groundwater for their drinking water, whether from community water systems or private wells. On an annual basis, groundwater discharge accounts for one-half to two-thirds of water flow in streams and rivers.

Protection of groundwater quality and quantity thus has multiple potential benefits, including:
- Protecting the quality and maintaining the available quantity of water supplies necessary for drinking water, irrigation and industry
- Maintaining base flows of streams to preserve aquatic ecosystems and run-of-river intakes
- Reducing "flashiness" of streams and associated mobilization of sediments
- Protecting the quality of water in streams during base flow conditions

Disturbance of the land surface promotes surface runoff at the expense of groundwater recharge but also carries with it an increased risk of groundwater contamination from the water that continues to infiltrate, both by intentional, lawful disposal activities or unintentional or unlawful spills or dumping. For this reason, land use was used as a proxy for groundwater protection.

An alternative approach to incorporating groundwater protection in the water services assessment would have been to use relative ratings of groundwater recharge rates. However, the assessment team concluded that ranking land based on its recharge rate was not appropriate because differences in recharge rate do not mean that the groundwater stored in the subsurface in different locations is any less useful. While higher recharge rates imply greater intrinsic vulnerability of the groundwater to contamination, land use is at least an equal factor in the likelihood of contamination.

Groundwater Recharge

The data produced by the South East Gap Analysis Project (segap_mosaic) was used to code values for groundwater recharge outside of discharge areas. The data was provided by Biodiversity and Spatial Information Center, USGS North Carolina Cooperative Fish and Wildlife Research Unit, N.C. State University.

Land Cover Type and Groundwater Recharge Classifications		
Classification	**Ranking for Water Services Assessment**	**Justification**
Row crops and quarries	3	Row Crop, Quarry/Strip Mine/Gravel Pit
Barren	4	Atlantic Coastal Plain Sea Island Beach, Atlantic Coastal Plain, Southern Beach, Bare Sand, and Bare Soil
Pasture and grasses	5	Grassland/Herbaceous, Other Herbaceous, Utility Swath – Herbaceous, and Pasture/Hay
Natural Cover	6	All other classes

Additional values of Open Water (Fresh), Open Water (Brackish/Salt), Open Water (Aquaculture), Developed Open Space, Low Intensity Developed, Medium Intensity Developed, High Intensity Developed were given no score.

Areas covered by the Riparian Zones/Floodplain data were defined as discharge and also given no score.

Future Water Supply

This data set has not been developed, however it is vitally important for North Carolina citizens that future sources of water be studied and protected.

Water Use / Consumption Category

As North Carolina grows, so does the demand for safe drinking water. Clean water is also highly valued for recreational activities such as swimming, boating and fishing, which enhance our quality of life and boost the state's economy.

Source Water Assessment Program Ratings

The Source Water Assessment Program within the Public Water Supply Section evaluates the susceptibility of drinking water supplies to contamination. All drinking water sources used by public water supply systems have a susceptibility rating. To quality as a water supply system, the facility must provide water for human consumption to at least 15 connections or 25 people.

The susceptibility rating of higher, moderate or lower for each source is determined by combining the results of the source's inherent vulnerability rating and the contaminant rating.
- Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer.
    - The inherent vulnerability rating of groundwater sources is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well construction integrity.
    - The inherent vulnerability rating of surface water sources is determined based on an evaluation of the watershed classification, intake location, raw water quality data (i.e., turbidity and total coliform) and watershed characteristics (i.e., average annual precipitation, land slope, land use, land cover, groundwater contribution).
- The contaminant rating is based on an evaluation of the density of potential contaminant sources and their proximity to the water supply intake within the delineated assessment area.

For a more detailed description of the SWAP please visit the Web site at
http://swap.deh.enr.state.nc.us/swap

Source Water Assessment Program Ratings Classifications		
Susceptibility Rating	Ranking for Water Services Assessment	Justification
Higher	8	Areas with a higher susceptibility rating reflect the drinking water sources that are most susceptible to contamination. Based on the assessment process, these areas may have many potential contaminant sources in close proximity to intake and the watersheds or aquifers are most susceptible to nonpoint and point source contaminants due to their characteristics. These areas warrant a high ranking in the Water Services Assessment because they provide an invaluable service to the citizens of the state and they would benefit most from protection efforts through land conservation.
Moderate	6	Areas with a moderate susceptibility rating also provide an invaluable service to the citizens of the state and would benefit from protection efforts through land conservation; however, they have a moderate Water Services Assessment ranking because are not the most susceptible to contamination.
Lower	4	Areas with a lower susceptibility rating have a low Water Services Assessment ranking because while they also provide an invaluable service to the citizens of the state and they would benefit from protection efforts through land conservation, they are least susceptible to contamination.

Shellfish Sanitation

The Shellfish Sanitation Section is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption. Recommendations are made to the Division of Marine Fisheries through the state health director to close those waters that have the potential for causing illness and opening those that are assured of having clean, healthy shellfish.

All shellfish growing areas are classified in accordance with National Shellfish Sanitation Program guidelines as outlined in the *Guide for the Control of Molluscan Shellfish* and administered by the U.S. Food and Drug Administration. Sanitary surveys are conducted in all shellfish growing areas every three years to document all existing or potential pollution sources, to assess the bacteriological quality of the water, and to determine the hydrographic and meteorological factors that could affect water quality. Water samples are collected at least six times a year from each growing area and tested for fecal coliform bacteria, which are an indicator that human or animal wastes are present in the water. This information is then used to classify each shellfish growing area as either approved, conditionally approved or prohibited. In addition, reviews of bacteriological data and pollution sources are conducted annually.

Shellfish Sanitation Classifications		
Classification	**Ranking for Water Services Assessment**	**Justification**
Approved Shellfish Areas	9	Growing areas can be classified as approved for harvest when a sanitary Survey finds that the area is safe for the direct marketing of shellfish for human consumption; not subject to contamination for human or animal fecal matter at levels that presents an actual or potential public health hazard; not contaminated with pathogenic organisms, poisonous or deleterious substances, marine biotoxins; or bacteria concentrations exceeding approved area criteria. Approved shellfishing areas are consistently open to shell fishing but can close due to emergency situations like an unusual storm event. These areas are given a high Water Service Assessment ranking because they both indicate high water quality and provide a significant resource to citizens in North Carolina and beyond.
Conditionally Approved Open Areas	9	Conditionally approved open areas are growing areas that meet the approved area classification when the conditionally approved classification is in the open status. Management plan is developed to determine the event that would cause the area to close. Usually temporary closures are due to a significant rain event that causes stormwater of runoff. Areas remain closed until sampling indicates the area is safe for harvest for direct consumption. These areas are given a high Water Service Assessment ranking because they both indicate high water quality and provide a significant resource to citizens in North Carolina and beyond.
Conditionally Closed Areas	5	These areas are closed most of the time; however may be opened on a temporary basis when conditions of the management are met and sampling of both water and shellfish meats meet approved area criteria. Conditionally closed areas are usually opened when stormwater runoff is at a minimum. These areas are given a moderate Water Services Assessment Ranking because while they provide a significant resource to citizens, they indicate poor water quality.

Recreational Waters

The mission of the Recreational Water Quality Program is to protect the public health by monitoring the quality of North Carolina's coastal recreational waters and notifying the public when bacteriological standards for safe bodily contact are exceeded. They do this by monitoring for enterococcus bacteria, an indicator organism found in the intestines of warm-blooded animals. While it will not cause illness itself, its presence is correlated with that of organisms that can cause illness. If a single sample exceeds the standard for the area, a swimming advisory may be posted until the water returns to a safe bacteriological level.

The coastal waters monitored include swimming areas along ocean beaches, sounds, bays and estuarine rivers. The program defines a "swimming area" as a coastal recreational area that is used for primary contact located within waters classified by the Division of Water Quality as SA, SB or SC. The swimming areas are classified as Tier I, II and III based on the frequency of public use (see complete definitions below).

The program tests 240+ swimming areas, most of them on a weekly basis. Swimming season runs from April 1 to Oct. 31. Starting in April running through September all ocean beaches and high-use sound-side beaches are tested weekly. Lower-use beaches are tested twice a month. In October all sites are tested twice a month and once monthly from November through March.

Recreational Waters Classifications		
Classification	Ranking for Water Services Assessment	Justification
Tier I Swimming Areas	8	A swimming area used daily during the swimming season, including any public access swimming area and any other swimming area where people use the water for primary contact (in which a person's head is partially or completely submerged), including all oceanfront beaches. These areas were given a relatively high ranking because they represent areas that provide an important water use for residents and tourist in our state.
Tier II Swimming Areas	7	A swimming area used on an average of three days a week during the swimming season. These areas were given a slightly lower ranking than Tier I because they are used slightly less often
Tier III Swimming Areas	5	A swimming area used on an average of four days a month during the swimming season. These areas were given a lower ranking because the are used the least often of the three areas.

Designated Rivers

Designated rivers represent both use/consumption and water quality issues. There are several categories of designation explained below. Each requires different levels of quality and/or supports more than one use.

| Designated Rivers Classifications		
Classification	Ranking for Water Services Assessment	Justification
National Wild and Scenic River	8	The National Wild and Scenic Rivers Act protects designated rivers that have Outstanding Remarkable Values (ORVs) such as scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values. These river segments and their immediate riparian environments are to be protected in their free-flowing condition for the benefit and enjoyment of present

		and future generations. Free-flowing conditions increase the biological connection, and protection along these rivers provide protection of ORVs and high quality waters, therefore this data set was ranked relatively high.
State Natural and Scenic Rivers	8	State Natural and Scenic Rivers are components of the State Parks System that have been designated in accordance with the Natural and Scenic Rivers Act of 1971. State Rivers designated under this act possess outstanding natural, scenic, educational, geological, recreational, historic, fish and wildlife, scientific and cultural values, and are protected from the construction of dams, reservoirs, and other water resources projects. Free-flowing conditions increase the biological connection, and protection along these rivers provide protection of ORVs and high quality waters, therefore this data set was ranked relatively high
State Scenic and Recreational Trails	8	State Scenic and Recreational Trails are components of the State Parks System that have been designated in accordance with the North Carolina Trails System Act of 1973. State Trails designated under this act are intended both for recreational value, and to provide for the appreciation of natural areas and for the conservation and enjoyment of the significant scenic, historic, natural, ecological, geological or cultural qualities of the areas through which such trails may pass. State Trails may be designated along river corridors. This category of designation provides protection of multiple outstanding resources.
Congressionally Authorized Study Rivers	7	The National Wild and Scenic Rivers Act provided some measure of protection for certain rivers while they are studied to determine if they met the eligibility criteria for designation. These studies are authorized by the U.S. Congress. This category ranked lower than the previous due to their study status.
U.S. Forest Service Eligible Rivers	7	These river segments are located within the proclamation boundary of a National Forest or adjacent to it. They are viewed as eligible for the Nation Rivers System by the U.S. Forest Service. This category ranked lower than the previous due to their study status.
National Rivers Inventory Segment	5	The National Rivers Inventory is a listing of free-flowing river segments that possess one or more ORVs. These river segments may potentially qualify as National Wild, Scenic or Recreational rivers, State Natural and Scenic Rivers or State Scenic and Recreational Trails. These rivers are more numerous and are listed only as "potential qualifiers", therefore this category received the lowest river designation ranking.

Water Services Assessment Legend

Legend

Water Services Assessment

Relative Conservation Value

- 13-16
- 10-12
- 8-9
- 5-7
- 1-4
- Unrated
- Impervious surface

Weighted Scale for Ranking Water Services		
Conservation Value	Ranking Range	Possible Bonus Points (if multiple values are identified)
moderate	1 - 4	.5
medium	5 - 7	1
highest	8 -10	1.5

Additive Approach: If a cell contains multiple occurrences of resources, then points can be added to the maximum score, reflecting the additional conservation value.

Key to Identify Tool results for the Water Services Assessment		
Category Name	**Value**	**Individual Input Layers**
Primary Classifications - *Division of Water Quality*		
	10	Water Supply I (WS-I) Division of Water Quality
	9	Water Supply II (WS-II)
	7	Water Supply III (WS-III)
	5	Water Supply IV (WS-IV)
	4	Water Supply V (WS-V)
	4	Class _SC (General Purpose saltwater)
	7	Class _SB (Recreation Saltwater)
	4	Class _C (General Purpose freshwater)
	7	Class _B (Primary Recreation freshwater)
Supplemental Classifications- *Division of Water Quality*		
	6	Future Water Supply (FWS)
	9	High Quality Waters (HQW)
	10	Outstanding Resource Waters (ORW)
	9	Unique Wetland (UWL)
	5	Benthos Database, Good
	9	Benthos Database, Excellent
	5	Fish Community Database, Good
	9	Fish Community Database, Excellent
Wetlands		
	9	CREWS, Exceptional - *Division of Coastal Management*
	6	CREWS, Substantial
	2	CREWS, Beneficial
	5	National Wetland Inventory (NWI) - *US Fish and Wildlife Service*
Other Data Sets		
	8	Head Waters (needs to be developed)
	9	Native Trout Waters - *Wildlife Resources Commission*
	2	Riparian Zones and 100 Year Flood Plains
Groundwater Recharge - *South East Gap Analysis Project*		
	3	Row crops and quarries
	4	Barren
	5	Pasture and grasses
	6	Natural Cover

Future Water Supply		
		(needs to be developed)
Source Water Assessment Program Ratings - *Public Water Supply Section*		
	8	Higher Susceptibility Rating
	6	Moderate Susceptibility Rating
	4	Lower Susceptibility Rating
Shellfish Sanitation - *Division of Marine Fisheries*		
	9	Approved Shellfish Areas
	9	Conditionally Approved Open Areas
	5	Conditionally Closed Areas
Recreational Waters - Recreational Water Quality Program		
	8	Tier I Swimming Areas
	7	Tier II Swimming Areas
	5	Tier III Swimming Areas
Designated Rivers		
	8	National Wild and Scenic River
	8	State Natural and Scenic Rivers
	8	State Scenic and Recreational Trails
	7	Congressionally Authorized Study Rivers
	7	U.S. Forest Service Eligible Rivers
	5	National Rivers Inventory Segment